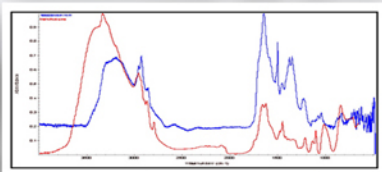




Innovation @ WSTF 2011

Propellant Distillation-Conditioning MMH

Out-of-Spec MMH at WSTF



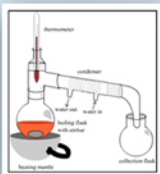
A survey was performed on all hypergolic propellants at WSTF to determine which were contaminated and what quantities of contamination were present. Stored monomethylhydrazine (MMH) was determined to have the greatest quantity of contamination. Sampling showed nonvolatile residue (NVR) concentrations as high as 30 mg/L exceeding the NASA Spec SE-S-0073 maximum of 10 mg/L.



Over 3000 gal of out-of-spec MMH are stored in the 300 and 400 Areas. Contamination resulted from the interaction with atmospheric components during handling and transferring of MMH. Rather than treating and disposing of the out-of-spec MMH, the feasibility of conditioning it into in-spec MMH was proposed as a cost-effective and environmentally friendly alternative.

The value of 3000 gal of MMH is \$1.9 M. Treating and disposing this amount would cost ~\$800K.

Distilling NVR out of MMH



MMH Chemical & Physical Properties	
Melting Point	-63 °F
Boiling Point	191 °F
Liquid Density	50.4 lb/ft ³
Autoignition Temperature	363 °F

NVR Constituents	Formula	Boiling Point (°F)
MMH	NH ₂ CH ₃	191
Nitrogen	N ₂	-321
Dimethyldiazine	CH ₃ N=NCH ₃	~35
Ethylene oxide	C ₂ H ₄ O	52
Ammonia	NH ₃	-28
Methylamine	CH ₃ NH ₂	21
uns-Dimethylhydrazine	(CH ₃) ₂ NNH ₂	145
sym-Dimethylhydrazine	CH ₃ NNHCH ₃	179
Formaldehyde methylhydrazine	CH ₃ NNH=CH ₂	NA
Methoxyethane	CH ₃ OCH ₂ CH ₃	46

Distillation is the separation of constituents of a liquid mixture via partial vaporization of the mixture and separate recovery of vapor and residue. It is based on the volatilities of substances being separated and by the addition and removal of heat. Any compound that can evaporate can be separated from nonvolatile substances using this technique and extra waste is not generated. The process materials are non-selective and can be used with any propellant as long as the boiling point range and autoignition temperature is known. The still can also be constructed with compatible materials, easily stored, cleaned, and operated. In addition, distillation is used at WSTF to determine the concentration of NVR in a 100 mm sample by evaporating the propellant from the sample and collecting only the contamination (Chem Lab).

Procurement of an MMH Distillation Unit



A WSTF multi-departmental team was assembled to write the statement of work to procure a reusable distillation unit that meets WSTF Safety, Design, Quality, Material Compatibility, Mechanical and Electrical and Fabrication requirements. The contract was awarded to DivInd LLC from Chandler, AZ in December 2010.

Procurement of an MMH Distillation Unit

The DivInd and WSTF teams are currently working on the design of the unit. These activities include:

- Preliminary FMEA
- Component Selection
- PV/S Design Document
- Reviewing/Developing Operational Procedures
- RF Survey

Many reviews, inspections, and the writing of all pertinent Facility Baseline Documentation is coming!

Target Operation Period → September 2011

